Prismedical Corporation – Triton™ Personal Water Purification Unit

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Device Information

The Prismedical Triton Personal Water Purification Unit is a passive, handheld water treatment device consisting of a plastic purification pack (canister about the size of an aluminum drink can), two vinyl bags, and rubber tubing for connections. The device is operated by connecting the raw water bag to the influent side (top) of the purification pack with supplied tubing, and similarly the product water bag to the effluent or bottom of the purification pack. The connections on the pack and the tubing are designed to prevent connecting the bags in the reverse order. Untreated water is then poured into the raw water bag and the device is hung several feet off of the ground to allow for gravity water flow through the device. The raw water bag holds about 3 L of water and contains a 15 µm asymmetric depth filter. The pre-filter is charged to increase pathogen removal and, according to the manufacturer, has characteristics of membranes with much smaller pore sizes. The treatment unit consists of carbon, proprietary strong anion/ cation ion exchange resin, a 2 µm (nominal) glass macrofilter, and 0.2 µm (absolute) microfilter. The product water bag is vinyl, holds about 3 L, and is distinctly different in appearance from the raw water bag. The manufacturer claims multiple barriers for pathogens throughout the device due to chemically modified components, where no one step mitigates a single category of contaminant. Although the device will operate on gravity alone, pressurizing the system by means of pressing or sitting on the raw water bag will dramatically increase the flow rate. This device uses no chemicals for pathogen reduction and therefore imparts no taste and presents no health concerns. The Triton Personal Water Purification Unit evolved from another device that Prismedical produces called the Mainstream™ Water Purification Device. The Mainstream device targets the production of sterile water from a purified drinking water source and is a U.S. Food and Drug Administration-approved device for medical use. The Mainstream™ contains slightly different pathogen reduction mechanisms, excluding the prefilter, in comparison to the Triton. Due to limited data received on the Triton™ where applicable, data for the more thoroughly studied Mainstream will be substituted and noted.

Effectiveness Against Microbial Pathogens

No data was received showing the pathogen reduction capabilities of this device when challenged against the U.S. Environmental Protection Agency (USEPA) Guide Standard and Protocol for Testing Microbiological Water Purifiers (reference 1). The protocol used in

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microbial challenge studies for the Triton was based on that used for the Mainstream device, and is different than testing protocols commonly used for drinking water purification. Testing data received for both devices followed the Health Industry Manufacturers Association (HIMA) Microbiological Evaluation of Filters for Sterilizing Liquids protocol (reference 2). This protocol, designed to test devices used to create sterile water for medical purposes, contains stringent bacterial reduction requirements, but lacks worst-case challenge water incorporating elevated turbidities and changes in pH and water temperature. Based on the pathogen reduction mechanism of the Triton and the data received that was conducted independently using the Mainstream, bacteria reduction is expected to exceed the 6-log requirement of the USEPA Guide Standard (reference 1). The HIMA protocol does not require cyst reduction challenges due to their size being many times larger than bacteria. Given the reduction mechanisms, cyst reduction should exceed the requirement of reference 1. No data was reviewed for virus reduction. Based on the reduction mechanism, data received by the manufacturer for the Mainstream, and conversations with the manufacturer, virus reduction to the requirements of reference 1 is expected. Since the primary mechanism of virus reduction is adsorption, and this process can be affected by turbidity (particulates) and pH, testing for virus, as well as bacteria and cysts, against reference 1 is critical to confirm expected reductions. Additionally, published data (reference 3) was received for the Mainstream that showed bacteria and virus reduction capabilities. Excellent reductions were shown using USEPA-grade drinking water spiked with each pathogen. Since the Mainstream is similar to the Triton, these results support the assumptions made on pathogen reduction, but confirmation is needed incorporating worst-case water quality. This device is assigned one √ for each pathogen (for an explanation of the rating checks click here) based on treatment technology.

Table. Expected Performance Against Microbial Pathogens.

Microbial Pathogen Type	Expected Disinfection Capability	Evaluation Rating	Pathogen Reduction Mechanism
Bacteria	> 6-log	√	size exclusion
Viruses	> 4-log	√	adsorption, ion exchange
Giardia cysts	> 3-log	√	size exclusion
Cryptosporidium oocysts	> 3-log	√	size exclusion

Production Rate and Capacity

Inherent to the production rate and capacity of filtration devices is the quality of the raw water source. Manufacturer stated production rate is 0.075 L/min for gravity production at 1.1 psi, and 0.2 L/min when pressurized to 5 psi. Independent laboratory data reviewed for flow rate with the Mainstream, using gravity flow and no appreciable turbidity, showed the production of 3 L of water in about 60 minutes (0.050 L/min). Pressurizing the system to about 5 psi, decreased the time to produce 3 L to about 20 minutes, corresponding to a flow rate of 0.150 L/min. The addition of particulates decreased production rate. Prismedical in-house data using the Triton with water having a relatively low turbidity of about 1 NTU and no microbial challenge, showed flow rates of 0.060 – 0.090 L/min for the first 100 L produced and dropping down to about 0.004 L/min by the device capacity limit of 200 L. Device capacity is stated to be 200 L but will vary widely with raw water turbidity.

Cleaning, Replacement, and End of Life Indicator

When production rate decreases, the raw water bag can be turned inside out and the pre-filter can be cleaned by scraping particulates off and rinsing the membrane with water. Raw water is acceptable to use for cleaning the pre-filter. The treatment unit is not designed to be backwashed and once clogged must be replaced. If production cannot be restored to a practical rate, or after 200 L of water have been processed, the device must be discarded. After the device has processed 200 L of water the unit should be discarded regardless of production rate since the ion exchange resin may be exhausted. This device does not contain an indicator of process failure or end of useful life indicator besides clogging. There are no replaceable parts for this device.

Weight and Size

The dry weight of the device is 500 grams. Dimensions are as follows:

Overall Device (H x diameter)	16 cm x 12 cm
Purification pack (H x diameter)	11.5 cm x 7 cm
Raw and treated water bags (foldable, each) (L x W)	43 cm x 18 cm
Tubing (2 pieces, each)	43 cm

Cost

Triton (GSA price)	$57.82

Device Evaluation

The Prismedical Triton Personal Water Purification Unit has not been challenged against the requirements of the USEPA Guide Standard and Protocol for Testing Microbiological Water Purifiers (reference 1). Data received for bacteria reduction by an independent laboratory (reference 4) followed the HIMA protocol, and although pathogen reduction requirements were met, water characteristics used during testing are not considered worst-case challenge in accordance with reference 1. Based on treatment technology, bacteria reduction to the requirements of reference 1 are expected. No data was received for cyst and virus reduction. Based on membrane pore size, excellent cyst reduction is expected. Based on treatment technology, published data for the Mainstream device, and discussions with the manufacturer, virus reduction is expected to exceed the 4-log requirement of reference 1 (reference 5). Pathogen reductions need to be confirmed by testing the device against the full USEPA Guide Standard and Protocol (reference 1). Since virus reduction is by adsorption, water quality will affect efficiency. Additionally, the device has a finite capacity for virus adsorption. Therefore, it must be demonstrated that this device can not only meet the reduction requirements for viruses as well as for bacteria and cysts, but do so to the stated capacity of 200 L. This device requires no chemical addition and no wait time prior to water consumption. There is no indicator of process failure on a real-time basis, and end of device useful life is based on filter clogging, or by the user keeping track of the volume of water purified. Inherent to treatment devices utilizing small pore size membranes is the likelihood of clogging when processing highly turbid raw water. Although this device uses a pre-filter that is able to be mechanically cleaned, this inherent disadvantage is still valid. The large surface area of the pre-filter is advantageous when used with turbid waters. Throughout the use of the device, water production rate is expected to decrease considerably and will be affected by water quality. Since this device requires gravity flow or the application of pressure, such as by sitting on the raw water bag, using the device on the move may not be feasible. The manufacturer states that the canister can be used as an in-line filter when accompanied by a hydration pack, but no information was received as to the effort on the user's part to pull water through the device. The manufacturer states full accountability by Prismedical employees during the manufacturing process, but no manufacturing specific information or quality control data was received for this device. No information was received on the storage life or required storage conditions for this device.

Advantages

- Independent and published data using a similar device showed excellent bacteria and virus reduction. Excellent cyst reduction is expected based on treatment technology. [No results were received using worst case (e.g., elevated turbidity) challenge water.]
- No chemicals required.
- No wait time prior to consumption.

- Large surface area pre-filter with cleaning capability.

Disadvantages

- No data showing pathogen reduction capabilities in accordance with the USEPA Guide Standard and Protocol for Testing Microbiological Water Purifiers (reference 1).
- Slow water production rate.
- No real-time indicator of process failure.
- Device unable to be backwashed.

References

1. USEPA, 1989. Guide Standard and Protocol for Testing Microbiological Water Purifiers. *Federal Register*. 54:34067.

2. HIMA, 1982. Microbiological Evaluation of Filters for Sterilizing Liquids. HIMA Document No. 3, Vol. 4.

3. Taylor, M.A., et. al., 2004. Remote Site Production of Sterile Purified Water from Available Surface Water. *Prehospital and Disaster Medicine*. 3:266-277.

4. Independent laboratory data supplied by Prismedical showing bacteria and virus reduction.

5. U.S. Army Center for Health Promotion and Preventive Medicine, 2005. *Technical Information Paper; Filtration in the Use of Individual Water Purification Devices,* Aberdeen Proving Ground, MD.

Device Evaluation Update – Feb 2006

Independent laboratory results for testing conducted by NSF International was received that tested the Prismedical Triton Personal Water Purification Unit against the USEPA Guide Standard. Testing was conducted using the ceramic candle portion of the protocol with a production volume of 4 L/day for 10.5 days. The flow rate was 0.075 L/min. Results indicate that this device is capable of >6-log reduction of bacteria, and >3-log reduction of *Cryptosporidium parvum*. This device met the > 4-log reduction of both rotavirus and poliovirus during initial testing. On day six virus reduction decreased to below the 4-log requirement. By day 7 the device was well under the 4-log requirement. During this time, bacteria and cyst reduction remained constant. On day 8, after 24 L of relatively clear type 1 water and 4 L of turbid type 2 water, the units clogged, ending testing for this device. During testing on day 7 the

turbidity of the water was about 290 NTU, well above the ≥30 NTU requirement. It is unclear if this device would have clogged prior to day 10 using the lower NTU water. The device showed decreased virus reduction prior to this increased turbidity water. Our original pathogen reduction ratings for this device were √ bacteria, √ virus, √ *Giardia*, and √ *Cryptosporidium* based on device technology. Based on this new data, it is questionable whether adequate virus reduction is likely. Furthermore, it appears that this device may have trouble meeting the 200 L manufacturer stated capacity using elevated turbidity waters. Until additional data becomes available indicating otherwise, it should be assumed that this device is incapable of meeting the virus reduction requirements and the new pathogen reduction ratings should be √ bacteria, X virus, √ *Giardia*, and √ *Cryptosporidium*.

Updated Table. Expected Performance Against Microbial Pathogens.

Microbial Pathogen Type	Expected Disinfection Capability	Evaluation Rating	Pathogen Reduction Mechanism
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Viruses	> 4-log	X	adsorption, ion exchange
Giardia cysts	> 3-log	√	size exclusion
Cryptosporidium oocysts	> 3-log	√	size exclusion

Reference:
Independent laboratory testing conducted November 2005. Testing sponsored by the Department of the Air Force, Air Force Materiel Command.